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THE BOTANICAL GAZETTE

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In the December number will appear:

Studies in the biology of the Uredineæ, I: Notes on germination, by Prof. M. A. CARLETON, *Kansas State Agricultural College, Manhattan.*

Botanical notes from Bainbridge, Georgia, by DR. AUGUST F. FOERSTE.

The bacterial flora of the Atlantic ocean in the vicinity of Woods Holl, *concluded. Plate XXXVI will accompany this part.*

☞ *Subscribers are requested to notice the announcement regarding the proposed enlargement of the* GAZETTE *for 1894.*

BOTANICAL GAZETTE

NOVEMBER, 1893.

On the food of green plants.[1]

CHARLES R. BARNES.

The constant tendency of biological science is to minimize the difference between the physiological processes of plants and animals, and to recognize, under the varying forms, a remarkable functional unity. External form and even function were studied long before it was known upon what, in essence, both depended. Dujardin, a zoologist, seeking in 1835 a name for the living matter of which some of the simplest animals were composed, selected the word "sarcode." Von Mohl, a botanist, seeing in 1846, in the cells of some plants, previously unnamed contents which he considered the simplest living material, called it "protoplasm." The acute Payen immediately suspected the identity of these two substances. Cohn in 1850 maintained this identity. But it was not till 1860 that Max Schultz definitely established it. This year 1860 marks an epoch, since modern biology takes thence its rise, thanks to Darwin and Schultz.

Having thus a common starting point in its physical basis, it was natural to expect that the manifestation of life in plants and animals should be essentially similar. Unfortunately, not only in the popular mind are the functions of plants and animals supposed to be radically unlike, but even in many scientific or pseudo-scientific text books they are either specifically or impliedly treated as belonging to totally different categories. And the popular notion is in reality derived chiefly from the text books; although the newspaper article is responsible for much "science falsely so called." This notion apparently depends in part upon the superficial, yet apparently radical, differences between the higher plants and the higher animals, and is deepened by the fact that we are con-

[1]Read before section G, A. A. A. S., Madison meeting, August, 1893.

scious animals and, looking at the plant from our point of view, assume an *a priori* difference.

Since the time of Linnaeus' dictum concerning the three kingdoms—"Minerals grow; plants grow and feed; animals grow, feed, and move"—text book writers, some even of the highest rank, have attempted to define the differences between plants and animals. These alleged differences have been growing fewer and fewer, and it is the purpose of this paper to show that another difference is only superficial, and so to demonstrate more completely the unity in diversity that exists in the physiology of living things.

Among the supposed differences between green plants and animals, none has been more persistently urged than this: Green plants live chiefly upon inorganic food, obtained in the form of CO_2, H_2O, and mineral salts; whereas animals require organic food. This statement is so trite that it is not necessary to cite any specific illustrations in evidence. It is conceded that the nutrition of fungi is essentially animal-like in the character of the food. These organisms require organic substances which have come into solution through physical or chemical causes independent of the fungus, or those which have been dissolved by chemical substances (generally enzymes) secreted by the fungus filaments. In passing it may be remarked that we have in the latter cases a process entirely like digestion in the animal stomach or in the food vacuole. In fact the term digestion, meaning the alteration of foods and their solution preparatory to absorption, is strictly applicable to this process, and ought to be applied to it.

In regard to the food of green plants, it must first be noticed that in a scientific sense the terms organic or inorganic are now obsolete, or at least obsolescent among chemists, just as the terms invertebrate and cryptogam have become obsolete in classification among biologists. The latter words are still popularly used because they conveniently indicate, in a very general way, a vast number of beings, which however have little in common except negative characters. Organic substances are popularly defined as those produced by the action of living things; but there are now known a multitude of carbon compounds which have not been found in organisms, but are genetically so intimately related to those which have been there produced, that they can not be excluded from the same group. As a single example I may cite the hydrazones,

by means of which sugars of a great variety have been identified and their relationships understood; yet no hydrazone, so far as we know, occurs in plants.

Again: There are many carbon compounds which, normally produced in living beings, have also been produced by synthesis outside the influence of life. As a single example of such I mention oil of wintergreen, which normally occurs in birch bark and wintergreen berries, but which is now produced commercially by synthetic methods. Many other essential oils are likewise manufactured.

Most organic substances therefore belong to a group more correctly known as carbon compounds, whose connection is very intimate. Among these compounds the most stable one, anhydrous carbon dioxide, CO_2, naturally finds a place. It occurs in nature, but is produced also as a result of destructive metabolism in organisms. Heretofore it has been called an inorganic substance. Furthermore, water occurs in nature, but is frequently produced by and in organisms. It too has been called inorganic. But the substances antecedent to these two in the descending scale of oxidation in the organism were called organic. The illogical nature of such a distinction is evident, at least in the case of CO_2.

I do not conceive it to be possible to use the terms organic and inorganic with scientific accuracy, because they are not scientific; but if we endeavor to use them as correctly as our present knowledge demands, we can not say that the food of green plants is inorganic, except in so far as the mineral salts, and possibly the water, are concerned.

This, however, may be considered a mere juggling of words, though I look upon the correct use of words as of especial importance in teaching. I propose to show, however, that neither CO_2, H_2O, nor mineral salts can properly or logically be considered the *food* of green plants.

When these substances are obtained by chlorophyll-bearing cells, as they are from the atmosphere and from the soil respectively, they do not exist as two independent compounds, nor does the CO_2 simply enter into solution in the water. On the contrary a new substance, H_2CO_3, is formed, which is carbonic acid.

Carbonic acid is far more readily decomposable than either of the stable compounds from which it originates. By the action of the protoplasm of the chlorophyll bodies, under the

influence of light of sufficient intensity, this H_2CO_3 is reduced, and a new compound of carbon is formed, of whose nature we are yet ignorant. It is supposed, on various *a priori* and experimental grounds, that this is one of the aldehyde group, probably formic aldehyde, CH_2O. The experiments of Bokorny upon the nutrition of Spirogyra seem to indicate the correctness of this idea. He endeavored to ascertain whether this plant could be supplied with any members of the aldehyde series in solution, and could then continue the same process or produce the same result as when it was supplied with H_2CO_3. Several of the simpler members of the aldehyde group proved deleterious,[2] but direct experiments with methylal ($C_3H_6O_3$) succeeded. This substance was supplied to starved, and hence starch-free, Spirogyra filaments in pure water, and access of CO_2 was prevented. With these conditions, under normal illumination, starch was quickly formed.[3] Not satisfied with this however, Bokorny succeeded[4] in obtaining the same result under similar conditions by using a nutrient solution containing 1:100 or 1:1000 of sodium oxymethylsulphonate, CH_3NaSO_4, which easily decomposes at a low temperature into formic aldehyde and sodic sulphite, $CH_2O+NaHSO_3$. Boehm's experiments with cane sugar[5] and, later, Arthur Meyer's[6] with levulose, dextrose, galactose, mannite and glycerin, show that the ordinary parenchyma cells of the green leaf can form starch from solutions of these substances supplied to starved (starch-free) leaves.

In view of these results, which do not stand alone, and are also supported by E. Fischer's work on the synthesis of sugars,[7] it can hardly be doubted that complex carbon compounds

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[2] Loew und Bokorny: Chem.-physiol. Studien über Algen. Jour. f. pract. Chem. xxxvi (1887). 272–291.

[3] Bokorny: Ueber Stärkebildung aus verschiedenen Stoffe. Ber. d. deutsch. bot. Gesells. vi (1888). 116–120. See also his Welche Stoffen können ausser Kohlensäure zur Stärkebildung in grünen Pflanzen dienen? Landw. Vers. Stat. xxxvi (1889). 229–242.

[4] Bokorny: Ueber Stärkebildung aus Formaldehyde. Ber. d. deutsch. bot. Gesells. ix (1891). 103.

[5] Boehm: Ueber Stärkebildung aus Zucker. Bot. Zeit. xli (1883). 33–38, 49–54.

[6] Meyer, A.: Bildung der Stärkekörner in den Laubblättern aus Zuckerarten, Mannit und Glycerin. Bot. Zeit. xliv (1886). 81–88, 105–113, 129–137, 145–151.—Cf. also Laurent: Sur la formation d'amidon dans les plantes. Bruxelles, 1888; *fide* Bokorny.

[7] Fischer, E.: Synthesen in der Zuckergruppe. Ber. d. deutsch. chem. Gesells. xxiii (1890). 2114. See also: Synthese des Traubenzuckers. l. c., p. 779.

arise in the manner indicated by von Baeyer in 1870,[8] viz., by condensation of formic aldehyde. Heretofore, following Sachs' path-breaking researches,[9] it has been believed that starch was not only the first visible product of this process, but that almost or quite all the material manufactured by the chlorophyll body passed at one time or another into the form of starch. The recent work of Brown and Morris,[10] however, proves conclusively that this is not the case. "It is far more probable," they say,[11] "that starch is only elaborated within the cell when the supply of nutriment is in excess of the cell requirements, and that most of the assimilated products never pass through the stage of starch at all." Their experiments "point to the somewhat unexpected conclusion that, at any rate in the leaves of the Tropaeolum, cane sugar is the first sugar to be synthesised." This accumulates in the cell-sap, and when its concentration "exceeds a certain amount . . . . starch commences to be elaborated by the chloroplasts." They add: "Our analyses point to the cane sugar being translocated as dextrose and levulose, and the starch as maltose, the latter process only taking place when the starvation of the cell has induced the dissolution of the starch."

The substances standing between formic aldehyde, CH_2O, and the sugars produced by this process are, however, not certainly known, and from the inherent difficulties surrounding the investigation, as well as the instability of the substances themselves, may not be known for a long time.

For our present purpose the only question of importance is whether the C, H, and O are, either in the form of H_2CO_3, or after partial reduction, or in their nascent condition after dissociation, combined with the protoplasm which later forms starch, as is urged by various writers. If they are so combined, then H_2CO_3 must be looked upon as a *food*, and the process be termed assimilation in accordance with long usage in animal physiology.

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[8] Baeyer, A. von: Ueber die Wasserentziehung und ihre Bedeutung für das Pflanzenleben und die Gährung. Ber. d. deutsch. chem. Gesells. III (1870). 63–75.

[9] Sachs: Ueber den Einfluss des Lichtes auf die Bildung des Amylums in den Chlorophyllkörnern. Bot. Zeit. XX (1862). 365–373.—Also, Ueber die Auflösung und Wiederbildung des Amylums in den Chlorophyllkörnern bei wechselnder Beleuchtung. Bot. Zeit. XXII (1864). 289–294.

[10] Brown & Morris: The chemistry and physiology of foliage leaves. Jour. Chem. Soc. LXIII (1893). 604–677.

[11] Loc. cit. p. 673.

1. Destructive metabolism in plants results in the decomposition of protoplasm, with the production of CO_2 and H_2O. The residue may probably be again combined with C, H, and O, to rebuild protoplasm. Can this be done in the green leaves? Is it accomplished there? For such repair we know that carbohydrates disappear, and that such repair is going on in all living parts, whether green or not. It is conceded that in no part not green could H_2CO_3 be used in this way. Presumptively, therefore, it is not so used in these parts.

2. The amount of H_2CO_3 used by the plant under normal illumination is much greater than necessary to repair waste, and also much greater than the amount necessary to form the starch which appears in the chloroplast. To account for this, on the supposition that starch and similar carbohydrates arise in the chlorophyll body by the actual decomposition of protoplasm, it is necessary to suppose that in the chlorophyll body the protoplasm combines C, H, O, N, and S, at least, *de novo*, to form proteids; or else that the products remaining after the starch is formed from protoplasm are continually rebuilt from the C, H, and O, derived from H_2CO_3. This is a much more complicated process than polymerization of formic aldehyde, and it is by so much more improbable. Moreover it rests, as I believe, upon insufficient observation and faulty deductions from these observations.

Note the point: That carbohydrates *may* arise by the decomposition of protoplasm is, since it is irrelevant, not denied; but that the recomposition, the repair, of the protoplasm so broken down, is accomplished by the direct use of H_2CO_3 is highly improbable.

3. On the view that starch arises only from the decomposition of protoplasm, it is impossible to conceive of any reason why starch is absent from some spermaphytes and from the fungi in general. They are supplied often with food in excess; in favorable circumstances the protoplasm is abundant and active, but however abundant the food or active the protoplasm it never decomposes into starch.

We shall harmonize vegetable physiology best with animal physiology by taking a different view of these processes, one which is not opposed by any observation yet made, so far as I know, and one which is from the chemical side highly probable.

The process in my view is this: Assuming a supply of

CO_2 and H_2O in the presence of chlorophyll bodies furnished with radiant energy of sufficient intensity, there occurs a rearrangement of the molecules of C, H, and O into some simple compound, probably formic aldehyde. By definite changes, probably polymerization, this becomes more and more complex, until finally one of the higher carbohydrates is produced, generally one of the sugars.

I believe that these changes occur through the action of the living protoplasm of the chlorophyll body, but that the H_2CO_3 *is not brought into such relation to the proteid molecules as to form any part of them.* The energy necessary to accomplish the work is supplied in the form of light. The chlorophyll of the chromatophore acts as an absorbent of the rays which are useful in doing the work, as Timiriazeff has shown,[12] and not as a shield.

The process here described has been called "assimilation," "assimilation proper," and "assimilation of carbon." I think that none of these terms is appropriate.[13] Assimilation has been long used in animal physiology to designate the appropriation of digested food by the different tissues, and its conversion into the substances of those tissues. In that general sense it ought to be used in vegetable physiology, or, if it can not be so used, it ought not to be used at all. We have an opportunity to use it so, if we apply it to those changes by which the complex carbon compounds produced by the green cells are appropriated by the various tissues, and made a part of them. Moreover, since in many instances the reserve food is in a solid form, there is in plants a process of *digestion* by which this solid food is altered and dissolved in order that it may be assimilated.

For the process of formation of complex carbon compounds out of simple ones under the influence of light, I propose that the term *photosyntax* be used.[14] The protoplasm, by the

[12] TIMIRIAZEFF: Enregistrement photographique de la fonction chlorophyllienne par la plante vivant. Compt. Rend. CX (1890). 1346–7.

[13] Cf. WIESNER: Elemente der wiss. Botanik I. 232. "Unter Assimilation versteht man gegenwärtig in der Pflanzenphysiologie die Umwandlung der Kohlensäure und des Wassers in organische Substanz. . . . Diese Auffassung stimmt mit der älteren, in der Thierphysiologie noch immer herrschenden, derzufolge Assimilation die Umwandlung der aufgenommenen Nahrungsmittel in die Bestandtheile der Gewebe bedeutet, nicht überein."

[14] WIESNER: l. c., p. 332: "Es scheint aber bei der im Texte gegebenen Begriffsumgrenzung an einem Worte zu fehlen für jenen wichtigen Process, den man bisher als Assimilation bezeichnete."

aid of light, marshals the molecules into new array and brings bodies of them together into new forms, as the individuals of an army are arrayed in companies, and companies drawn up into regiments. I have carefully considered the etymology and adaptation, as well as the expressiveness, of the word proposed, and consider it preferable to photosynthesis which naturally occurs as a substitute. Its derivation is evident: φως, light; συνταϭϭειν, to put together, to arrange, to organize.

This power, which is possessed by green plants alone, is a power over and above that which any animal possesses, except possibly those which may contain chlorophyll. (In most instances where chlorophyll has been found in animals, it has been shown either to be derived from ingested plants, or to be due to a symbiotic relationship between plants and animals, and all the problematic cases may yet be so solved.)

Much of the food so produced is already in soluble form. But carbohydrate reserve food often appears in solid form, particularly of starch and cellulose. How is such food utilized? Manifestly there must first be its alteration into a soluble condition. This is accomplished by the agency of alterative enzymes. From the action of diastase on starch a sugar, maltose, results, which may be translocated and utilized directly in repair and growth. Cellulose is altered and dissolved likewise. Even the already soluble cane sugar produced by photosyntax needs to be changed into dextrose and levulose in order to be translocated readily. What are these changes but *digestion?*

Under this view the nutrition of green plants resolves itself into three processes, photosyntax, digestion, and assimilation. Photosyntax deals only with carbohydrates; digestion and assimilation with all classes of foods.

Photosyntax is the synthesis of complex carbon compounds out of carbonic acid, in the presence of chlorophyll, under the action of light.

Digestion consists in chemical change and solution of the solid foods. It is due in large measure, perhaps entirely, to the action of alterative enzymes.

Assimilation is the conversion of the foods into the living or mechanical substances of the plant tissues for repair of waste and growth.

Food is the physiological term for all substances capable of

direct assimilation or of digestion and assimilation. It includes the carbon compounds produced by photosyntax and many other substances, but is not applicable to CO_2 and H_2O, which are built into carbohydrates.

By these slight yet important changes in terminology we bring ourselves into harmony with the present knowledge of animal physiology, and have a much more intelligible and intelligent point of view from which to discern further truths regarding plant nutrition.

University of Wisconsin.

The bacterial flora of the Atlantic ocean in the vicinity of Woods Holl, Mass.

A contribution to the morphology and physiology of marine bacteria.

H. L. RUSSELL.

WITH PLATE XXXVI.

(Continued from p. 395.)

General biological features of the different organisms.

Zymogenic properties.

The majority of the bacteria isolated at Woods Holl belong to the liquefying group of micro-organisms and one of their fermentative actions is demonstrated in the production of a peptonizing enzyme that slowly liquefies gelatin. The digestion of the casein in milk cultures also attests the production of ferments that change the insoluble proteids into soluble peptones.

Pathogenic properties.

From the frequency with which bacteria are found in the water and mud of marine areas, it might be presumed that the organisms in question had no pathogenic properties but were purely saprophytic in their nutritive adaptation. This presumption however is not warranted on *a priori* grounds and it becomes necessary in working out the full life history of a micro-organism to test the relation of the germ as to its pathogenic properties. For this purpose, white rats were inoculated with one cc. of freshly grown bouillon cultures of the

different predominating forms but in no case was there any evidence that would lead one to think that any of the species tested possessed any pathogenic peculiarities.

Relation to gaseous environment.

Of the different forms isolated this season, almost all are decidedly aerobic. No growth takes place in plate cultures covered with sterilized mica sheets and the manner of growth in gelatin tubes demonstrates their predilection for oxygen. Only one species, B. litorosus, manifested any indifference to its gaseous surroundings. This species thrived quite as well along inoculation track as superficially, and in cultures prepared according to Buchner's pyrogallic acid method, a marked growth was to be noted in nutrient bouillon.

Effect on nitrate solutions.

The effect of bacteria upon the nitrogen-containing compounds is an important one. The fertility of soils depends in a large degree on the oxidizing action of certain bacterial forms. These convert the ammoniacal compounds into the more available nitrites and nitrates. Beside these oxidizing agents, however, there are a large number of germs that possess the antagonistic property of reducing these salts to simpler substances. The Franklands[10] and Jordan[11] have studied a number of forms that were isolated from the soil and the water supplies and noted their ability to reduce nitrate solutions to both nitrite and free ammonia.

The species now under discussion were also subjected to a similar line of experiment to see if they had any effect on the nitrates that might be in marine waters.

The nitrate solution used as a nutrient medium had the following composition: 1^{gm} pept. sicc. (Merck's); 1.01^{gm} KNO_3 (c.p.); 1000^{cc} Lake Michigan water.

This water was examined chemically and no trace of nitrogen in the form of nitrite was to be found. Erlenmeyer flasks containing one hundred cubic centimeters of this solution were used for cultures and after inoculating them with the various forms of micro-organisms they were incubated at 35°C. for a period of twenty-four hours and then analyzed for nitrites by the sulphanilic acid and naphthylamine hydrochlorate test.

[10] Zeits. f. Hyg. VI. 373.
[11] Rep't Mass. State Bd. of Health. 1890.

In each case a marked reaction was noted, showing that the nitrate solution had been reduced and that nitrites were present in varying amounts. After four days' incubation at 35°C., the cultures were analyzed quantitatively for U as nitrite by colorimetric standards with the following results:

Total am't of N as KNO in culture solution,		14.00	parts in 100,000.
N as KNO_2 in culture of Bacillus limicola,		1.26	" " "
" " " " " " "	pelagicus,	2.8	" " "
" " " " " " "	maritimus,	2.1	" " "
" " " " " " "	litorosus,	2.3+	" " "

This indicates that the amount of nitrogen converted into nitrite from nitrate as a result of four days' growth of bacteria is by no means inconsiderable; in one case, B. pelagicus, reaching one-fifth of amount available. The marked difference to be noted in the amount reduced by B. limicola and B. litorosus is not to be explained by the difference in the rapidity of growth but is due to relative differences in reducing powers. At 35°C., B. litorosus grows much more slowly than at the ordinary temperature of the room, while the reverse is true of B. limicola. This relative difference in rate of development is however in inverse ratio to the amount of nitrogen reduced and shows that the denitrifying ability of the two germs differs to a considerable degree.

In order to determine whether the reduction process is carried on until free N or NH_4OH is produced, another culture test was made. The production of NH_4OH from nitrate can not be recognized by nesslerization as it is impossible to distinguish between NH_4OH that might come from the organic N in the peptone and that from the nitrate or nitrite, but by using a known amount of nitrate as a culture medium and then determining the amount present at the end of experiment, one is able to ascertain whether any considerable percentage has been reduced.

A normal solution of $NaNO_2$ was made, to which one per cent. of dry peptone was added. This was used as a culture medium and cultures of the several forms were examined as to amount of nitrite present after they had incubated for a period of five days. Growth of germs was evident in cultures but in no case was there any diminution of the amount of nitrite present, so the conclusion was evident that while the several species here described were able to reduce nitrates to nitrites, the later stages of the reduction process of nitrate to gaseous N were not carried on by these forms.

Experiments on insolation.

Although the fact that direct sunlight has a deleterious effect upon bacterial life in general has been known for a number of years[1 2] the full significance of this has not been generally appreciated until very recently. Carefully conducted experiments have shown that many of the pathogenic forms are profoundly affected by direct insolation not only when they are in a vegetating but in a quiescent spore stage as well.

The marine species isolated at Woods Holl have been tested in order to see whether forms naturally saprophytes were as easily affected as those accustomed to a parasitic mode of life.

Bouillon cultures not more than twenty-four hours old were used as seed. From these control gelatin plates were made by using one loopful of diluted culture. Two parallel sets of bouillon tubes, each containing two or three cc. of fluid, were also prepared by using one loopful of culture as seed. One of these was then wrapped in several folds of black tissue paper, care being taken to insert small pellets of cotton batting between the black paper and the glass of the tube, so as to diminish the effect of heat absorption and conduction to culture liquid as far as possible. These parallel sets of cultures were then exposed to the effect of direct sunlight during the day. At the close of the experiment, the culture tubes were filled with sterile gelatin and plate cultures made, so that the total number of germs could be directly ascertained, and compared with the control plate that showed the approximate number originally seeded.

Results of experiment were as follows:

Series inoculated and exposed to direct sunlight.
April 10th, 9 A. M. Sky clear, temperature varied from 15–21 ° C.
April 11th, sky cloudy all day.
April 12th, sky clear all day, temp. from 21–25° C.
April 13th, sky clear (cloudy from 1–3 P. M.), temp. 20–23° C.

Series planted on April 14th. Bouillon in "darkened" cultures appeared turbid with bacterial growth when unwrapped; the "exposed" tubes were perfectly clear and apparently unchanged. These tubes were now filled with sterile gelatin and plate cultures made with the following results:

NAME OF GERM.	NO. OF GERMS PLANTED AS "SEED."	NO. OF GERMS IN DARKENED CULTURE.	NO. OF GERMS IN EXPOSED CULTURE.
Bacillus maritimus	15	Several thousand	0
Bacillus litorosus	25	Several thousand	1
Bacillus pelagicus	420	Innumerable	0

[1 2] Downes & Blunt, Proc. Roy. Soc. 1877.

This confirms the work of other observers and shows that marine organisms are likewise susceptible in a high degree to the direct rays of solar light and that in a vegetative condition, they are easily destroyed in this way.

Distribution of species.

The distribution of species may be considered in two ways: first, as to area covered or superficial distribution; second, as to depth or bathymetrical range. The region examined at Woods Holl covered a larger area than at Naples, but the opportunity for determining the bathymetrical range was unfavorable owing to the extreme shallowness of the sea at this place.

The observations this season cover rather more than 100 square miles of the region of Buzzard's Bay and Vineyard Sound. The water forms were found to be distributed throughout the water masses very generally, as was likewise the case with those species indigenous to the mud.

Through the kindness of Prof. Wm. Libbey, Jr., opportunity was offered for the collection of material from the sea bottom that was secured by him on board of the U. S. Fish Commission schooner *Grampus*, at a distance of one hundred miles from mainland (New Bedford). The mud, consisting of globigerina ooze, was taken at the depth of 450^{fn} on the edge of the great continental platform that skirts the eastern coast of the United States. Only two samples were collected, but these sufficed to show that two of the more common mud forms that were to be found nearer the shore were also inhabitants of this locality. This instance, although isolated, suffices to show that the forms found in the mud are not locally distributed, but are spread over a considerable extent of the sea bottom.

This point is more strongly brought out when we compare the bacterial flora of this side of the Atlantic with that of the Mediterranean. Bacillus limosus was one of the most prevalent of the mud forms that was isolated in Mediterranean waters, and this same species has been identified by comparison of pure cultures brought from Naples with a form that is a common inhabitant of the sea slime at Woods Holl. The probable range of this cosmopolitan species can only be conjectured. It is a common form at Naples at the depth of 3,500^{fn}, and was also found abundantly on this coast as well as in the samples taken on the *Grampus* at the distance of 100 miles from land. Its presence at these three isolated localities testifies that its distribution is very general in the Atlan-

tic at least. Aside from this species, another mud form was secured on the *Grampus* that bore a very close resemblance to B. granulosus, a prevalent Neapolitan species. Careful comparison on same culture media of the germs from the two sources showed only slight differences, but these were scarcely more than would be expected of specimens coming from widely separated localities.

Concerning the distribution of those species that are common to this locality but unknown in the Mediterranean bottom, some observations are to be noted. First there is a marked difference as to the habitat of different species. Some are found solely in the mud layers, others are common to both water and mud.

Bacillus limicola, a common chromogenic species inhabits exclusively the ground layers of the sea bottom. In the vicinity of Woods Holl, it is a common form and was found in shallow places adjacent to the coast as well as in the deeper mud layers at a distance of ten to fifteen miles from land.

Three other forms, B. pelagicus, B. maritimus and B. litorosus which comprise, with the above mentioned species, the major portion of the bacterial flora of this locality, were found in both the water and the underlying ground layers. These were distributed throughout the water at all depths and B. pelagicus and B. maritimus were abundant in the samples of mud taken on the *Grampus* at a distance of 100 miles from land and in 450 feet of water.

Karlinski[13] has put forth a theory based upon the examination of one of the fresh water lakes in Bosnia that there is a horizontal zonary distribution of bacterial forms in water masses. He found, even within a vertical range of seventeen meters, a marked separation of the bacteria according to species. Forms common at the surface disappeared entirely in the deeper layers and were replaced by species peculiar to submerged strata. These results contravene those obtained at both this locality and at Naples. Here the study of the bathymetrical range of the different species has been limited on account of the shallowness of the sea, but the opportunity afforded by the dredgings from the *Grampus* showed that two forms, B. pelagicus and B. maritimus, were present in abundance at the depth of 450 feet as well as in the mud banks on the shore.

Much more favorable conditions for studying this question

[13] Loc. cit.

were had at Naples as the depth of the sea at this point is not inconsiderable.

Three of the most prevalent forms found in the Mediterranean sea bottom showed a vertical range exceeding 3,500ft, for they had not disappeared from cultures made from mud taken at this depth, and it is probable that their bathymetrical range was even considerably greater than this.

Concerning the relation between the superficial strata and extreme abysmal depths, we know nothing. If the relation between the higher forms of animal life hold in reference to bacterial forms, the presumption would be that there is a marked difference as to species between these layers. But such an analogy is inadmissible unless based upon observations, and these as yet are lacking.

University of Wisconsin.

(*To be concluded.*)

Plants hurt by a late freeze.

P. H. ROLFS.

In observing the effects of a frost in late spring many strange freaks are noticed. On the night of March 4, 1893, the thermometer went down to 29° F. at Lake City, Florida. The opinions as to whether harm was done were as various as the locations heard from. Closer observations showed that the following plants had suffered:

The variety of *Brassica oleracea*, known as "collards," is extensively grown for the kitchen and market. With considerable surprise I found that the young plants which had been set out had their larger leaves frozen. Further search showed the older plants that had shot up to flower drooping over. These racemes did not recover.

The largest and most beautiful of our wild violets, *V. sagittata* Ait., had the expanded portion of the petals, and in some cases the stigma frozen. Where, however, there was a slight protection, as a clump of saw palmetto or a blue berry bush, no harm was done.

Of the ornamental trees, the China tree, *Melia Azederach* L., suffered the most severely. It had made a vigorous growth; some young shoots were five or six inches long. All that were on low limbs less than eight feet from the ground were cut back to last year's wood, while those that were twelve feet or more from the ground were left unharmed.

Of the genus *Citrus* both *C. aurantium* L. and *C. vulgaris*

suffered and with scarcely any perceptible difference. If there was any, the favor was with the former, the sweet orange. The damage was confined to small trees not in bearing. The flower buds, not having opened on bearing trees, were unhurt.

The "zonale" geraniums exposed had leaves cut to the main stem.

On small trees of the prickly ash, *Xanthoxylum Carolinianum* Lam., the young growth of three inches was cut back to the wood; but when the tree was twenty feet or more tall the new growth was not hurt except on very low branches.

In the case of the common English peas there was quite a freak; the pods of a certain size were killed, while none of the rest of the plant sustained any injury.

Some of the earlier varieties of the peach had set young fruit; this was frozen, while the leaves remained entirely unhurt. All the fruit that had set and the open blossoms as well as those nearly open were killed.

The Kelsey plum in some cases had formed fruit which was frozen, while those trees that had not blossomed were left unharmed.

On *Prunus umbellata* Ell. the young leaves, and a very few of the flowers, showed signs of frost, but the leaves revived and some time later showed scarcely any signs of injury.

On the Le Conte pear none of the leaves were entirely frozen but many were frozen half way to the midrib. The blooms were not hurt excepting those that had receptive stigmas. As these trees are very liberal setters, I believe the most liberal, the damage to their crop was not perceptible.

The common old field blackberry, *Rubus cuneifolius* Pursh., had taken advantage of the three weeks of spring time and sent out young growth to the length of five inches; this was cut back to the old hard wood. Only a few flowers had opened and these were unhurt, as were also the flower buds and peduncles.

The crape myrtle, *Lagerstræmia Indica*, had its young shoots cut back to last year's wood.

The large birds nest thistle, *Cirsium horridulum* Michx., that grows all winter in the open field, could not stand this sudden fall in temperature; the upper and projecting leaves all hung down but the vital portion and the lower leaves were not hurt in the least.

Vaccinium nitidum Pursh had the open corolla, the exserted stigmas and the old leaves frozen; the young leaves, unopened corollas and small fruit were not hurt.

Vaccinium tenellum Ait. had the expanded corolla, exserted stigmas, young leaves and newly formed stems frozen. The young stems were two or three inches long. This species is evergreen with us.

It is curious that the old leaves on V. nitidum were frozen while on V. tenellum the young leaves suffered.

Pinguicula lutea Walt. on the moist pine barrens had the scapes frozen down to the surrounding débris. The scape was frozen to within four inches of the ground and the rest left unhurt.

Young tobacco plants where not protected were killed, but the beds in hammocks or on the edges of hammocks escaped.

Poke weed, *Phytolacca decandra* L., had grown to be a foot or more high, and was cut back to within four inches of the ground. Specimens that were somewhat protected wilted in the sun but recovered in a day or two.

Young beets that were about six inches high had the outer and higher leaves frozen.

Mulberry trees, *Morus alba* L., had grown enough to make a fine shade. The frost killed the younger leaves entirely and the older leaves were more or less hurt, so that it was difficult to find a perfect leaf within ten feet of the ground.

The figs, *F. carica* L., had to make a new start. They had made vigorous growth and the young figs were about the size of a large hazelnut.

Tradescantia zebrina was entirely frozen.

Paspalum læve had some leaves seven inches long. The outer and more exposed leaves alone sustained injury.

The above notes cover quite completely the plants that sustained injury from that frost.

Conclusion.—Most plants are very sensitive to frost during the period of rapid growth.

Portions of plants that have passed through colder weather may be injured by less frost under different conditions (e. g. *Vaccinium nitidum*, *Cirsium horridulum*). Of the twenty-five species more or less hurt by the frost, three are annuals, three biennials, and nineteen are perennials; eleven are herbs, five are shrubs, and nine are classed as trees. Of the fourteen shrubs and trees four are evergreen and ten deciduous.

Lake City, Fla.

Popular American plant names. II.

FANNY D. BERGEN.

THE present paper embraces the common names of North American plants, from Ranunculaceæ as far as Umbelliferæ, that have been added to my list since the publication of a preliminary list in the Journal of American Folk-Lore for April–June, 1892. The names under the remaining orders of phanerogams and a few names of cryptogamous plants will follow at an early date.

I would like once more to call the attention of botanists and folklorists to the interest and value of a somewhat complete collection of the kind which has been made in England, and to request that readers who are interested in the matter will kindly forward to me any names which they may know.

A large proportion of those which follow have been gathered from correspondents or by oral communications, though some have been taken from published local floras which are not readily accessible to botanists in general.

It is impossible publicly to thank every individual who has contributed to my collection of plant-names, but the following persons have extended such substantial assistance that it would be unfair not to mention here their names in connection with the work and cordially to thank them one and all for their generous help: —

Alger, Miss A. L.
Allen, J. A.
Barnes, Prof. C. R.
Beauchamp, W. M.[1]
Bebb, M. S.
Bessey, Prof. C. E.
Blochman, Mrs. L. E.
Briggs, Prof. F. R.
Dugger, S. M.
Ganong, W. F.
Ganong, Mrs. W. F.
Hayward, Rev. Silvanus
Hoke, Miss N. C.[2]
Hosmer, A. W.
Millspaugh, Dr. W. F.[3]
Newell, Miss Jane H.
Owens, J. G.[2]
Robbins, Mrs. Mary C.
Robinson, Dr. Benj. L.
Robinson, Rowland E.
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Seymour, A. B.
Slosson, Mrs. Annie Trumbull
Thurston, Prof. C. O.
Thurston, Miss Helen S.
Tower, S. F.
Vroom, J.
Walden, Mrs. C.

[1] Most of the New York names were contributed by Mr. Beauchamp, either from his own observations, or from Torrey's early list of New York plants, or from Miss Cooper's *Rural Hours*.

[2] These valued correspondents have died within the past six months.

[3] Almost all the West Virginia names are taken from Dr. Millspaugh's *Flora of West Virginia*, or from his *Bulletin No. 23* of the West Virginia Agricultural Experiment Station.

Walker, Francis A. Wilson, Prof. Andrew G.
Whiting, Miss Margaret C.

RANUNCULACEÆ.

Clematis Virginiana, devil's hair. Va.
Anemone patens, var. *Nuttalliana*, crocuses (by town children) Del. Co., Ia.; Rockford, Ill.
April fools.[1] Rockford. Ill.
hartshorn plant, headache plant, gosling, prairie smoke, crocus. Minnesota.
Anemone Virginiana, thimble-weed. West Va.
Anemone nemorosa, Mayflower. E. Mass.
Hepatica triloba, squirrel cups. N. Y.; Ferrisburgh, Vt.
heart liverwort. N. Y.
noble liverwort. Buckfield, Oxford Co., Me.
spring beauty. N. Y.
Anemonella thalictroides, Mayflower. E. Mass.
Thalictrum dioicum, quicksilver weed. Penobscot Co., Me.
Caltha palustris, cow lily. Hingham, Mass.
cowslops. Ferrisburgh, Vt.
meadow buttercup. New England.
Aconitum napellus, Adam and Eve. Washington Co., Me.
Cimicifuga racemosa, rattle-weed. Banner Elk, N. C.

MAGNOLIACEÆ.

Magnolia acuminata, yellow linn. West Va.
Liriodendron tulipifera, white, yellow, or hickory poplar. West Va.
cucumber-tree. N. Y.
magnolia. White Haven, Pa.

BERBERIDACEÆ.

Berberis pinnata, Span. Leña amarilla (yellow wood), Santa Barbara Co., Cal.
Berberis aquifolium, Oregon grape. Ore.
Podophyllum peltatum, mandrake pear. N. J.

NYMPHÆACEÆ.

Nelumbo lutea, water lily. Peoria, Ill.
great yellow water lily. N. Y.
Nuphar advena, bonnets. Fla.
gold watch. Mauch Chunk, Pa. (name perhaps not general there).
yellow pond lily. Ferrisburgh, Vt.
hog lily. Concord, Mass.

[1] Perhaps because they blossom about April 1, and are afterwards sometimes snowed under.

SARRACENIACEÆ.

Sarracenia purpurea, watches. Atlantic City, N. J.
fever-cup. Grand Manan Id., N. B.
huntsman's cup, forefather's cup, New England.
dumb watches or watch. Cape May Co., N. J.

PAPAVERACEÆ.

Sanguinaria Canadensis, puccoon. Banner Elk, N. C.
puccoon root. Anderson, Ind.
coon-root. West Va.
white puccoon, N. Y.
Dendromecon rigidum, tree poppy. S. Barbara Co., Cal.
Romneya Coulteri, Matilija poppy. S. Barbara Co., Cal.
Platystemon Californicus, *Platystigma lineare*, cream cups. S. Barbara Co., Cal.

FUMARIACEÆ.

Dicentra cucullaria, little boy's breeches. Central Iowa.
breeches flower. N. Y.
boys and girls. N. Y.
Dicentra Canadensis and *Dicentra cucullaria* called respectively (?)
ladies and gentlemen. Franklin Centre, P. Q.
girls and boys. Vt.
Dicentra Canadensis, wild hyacinth. N. Y.
Dicentra spectabilis, lady's ear-drops. Concord, Mass.
lady-in-a-boat. Franconia, N. H.

CRUCIFERÆ.

Dentaria laciniata, crow's foot. Anderson, Ind.
Dentaria diphylla, crinkle root. N. Y.
Draba verna, shad flower. West Va.
Hesperus matronalis, dame's violet. West Va.
Brassica sinapistrum, crowd-weed; Kraut-weed. West Va.
Brassica arvensis, water cress. West Va.
Capsella bursa-pastoris, pepper grass. Del. Co., Ia.; Concord, Mass.
shovel weed.[1] Penobscot Co., Me.
pickpocket. Ferrisburgh, Vt.
Lepidium campestre, Glenn-weed;[2] Glenn-pepper; crowd-weed. West Va.
Lepidium Virginicum, tongue grass. Del. Co., Ia.; Anderson, Ind.

[1] From the shape of the pods.
[2] So called from having first been noticed on the farm of a family named Glenn.

Lunaria biennis, gold-and-silver-plant. N. J.
Caulanthus procerus, *Caulanthus crassicaulis*, } wild cabbage. Cal.

CAPPARIDACEÆ.

Cleome spinosa, spider flower. West Va.

VIOLACEÆ.

Viola pedata, sand violet. Conn.
Viola pedata, pansy. Peoria, Ill.
snake violet; horse-shoe violet. Swansea, Mass.; Boston, Mass.
Viola pedata, var. *bicolor*, velvet violets, or (by children) velvets. Ga.
Viola palmata, roosters. Ferrisburgh, Vt.
Viola palmata, var. *cucullata*, Johnny-jump-ups. Banner Elk, N. C.
roosters. N. Y.
Viola Canadensis, hens. Ferrisburgh, Vt.
Viola tricolor, Johnny-jump-up. W. Mass.
battlefield flower.[1] Gordonsville, Va.

CARYOPHYLLACEÆ.

Dianthus barbatus, French pinks. Brunswick, N. Y.
bouncing Bet. Ferrisburgh, Vt.
Dianthus barbatus (scarlet, var.), scarlet lightning. Province Quebec.
Dianthus barbatus (white, var.), snow-flake. Province Quebec.
Saponaria officinalis, Boston pink. Poland, Me.; Wellfleet, Mass.
chimney pinks. N. H.
Silene cucubalus, rattle-box. Berkshire Co., Mass.
Silene laciniata, wild pink. S. Barbara Co., Cal.
Silene Armeria, dwarf French pinks. Brunswick, N. Y.
mock sweet William. S. Indiana.
old maid's pink. Canada and W. Mass.
Lychnis Githago, Licheta. Montpelier, Vt.

PORTULACACEÆ.

Portulaca grandiflora, moss. S. Indiana.
Claytonia perfoliata, wild lettuce.[2] S. Barbara Co., Cal.
Calandrinia Menziesii, mother's beauties. S. Barbara Co., Cal.

HYPERICACEÆ.

Hypericum proliferum, broom brush. West Va.
Hypericum perforatum, St. John. West Va.

[1] Because found so often on old battlefields, after the Civil War.
[2] Sometimes eaten by children as they would eat lettuce.

MALVACEÆ.

Malva rotundifolia, malice. Ferrisburgh, Vt.
Abutilon Avicennæ, American jute. West Va.
Hibiscus moscheutos, mallow rose. N. Y.

TILIACEÆ.

Tilia sp., daddy-nuts. Madison, Wis.

GERANIACEÆ.

Geranium maculatum, spotted geranium. Ferrisburgh, Vt.
Geranium Robertianum, wild geranium. N. Y.
Pelargonium tricolor, pansy geranium. Mooers, N. Y.
Pelargonium capitatum, rose-scented geranium; rose geranium; sweet-scented geranium. P. Quebec, Canada.
Oxalis acetosella, sheep sorrel. Jones and Del. Co., Ia.
Oxalis violacea, sheep sorrel. Peoria, Ill.
Oxalis corniculata, var. *stricta*, sheep sorrel. Peoria, Ill.; Ferrisburgh, Vt.; Anderson, Ind.
lady sour-grass. N. J.
Impatiens pallida, silver weed. N. Y.
Impatiens fulva, celandine. Buckfield, Me.; Ferrisburgh, Vt.
solentine. Penobscot Co., Me.
ear-jewel. Ferrisburgh, Vt.
wild celandine. Franconia, N. H.
wild balsam. Concord, Mass.
silver weed. N. Y.

RUTACEÆ.

Ptelea trifoliata, wafer ash. West Va.

RHAMNACEÆ.

Rhamnus Californica, wild coffee; bearberry. S. Barbara Co., Cal.

VITACEÆ.

Vitis cordifolia, fox grapes. Ferrisburgh, Vt.
Vitis rupestris, sand grape; sugar grape. West Va.
Vitis vulpina, bull grape. Ala.
Ampelopsis quinquefolia, five-fingered ivy; American joy. N. Y.

SAPINDACEÆ

Acer saccharinum, hard maple. Jones, Linn, and Del. Cos., Ia.
Acer rubrum, soft maple. Jones, Linn, and Del. Cos., Ia.

ANARCARDIACEÆ.

Rhus glabra, senhalenac.[1] Ferrisburgh, Vt.
Rhus venenata, poison elder. Ala.

POLYGALACEÆ.

Polygala paucifolia, May wings. Conn.; N. Y.
gay wings. Ferrisburgh, Vt.; N. Y.
baby's slippers. W. Mass.
Indian pink. Montague, Mass.

LEGUMINOSÆ.

Baptisia tinctoria, shoo fly. West Va.
Baptisia lanceolata, gopher-weed. Ga.
Crotalaria sagittalis, wild pea.[2] Ia.
Lupinus littoralis, Chinook liquorice. Washington, D. C.
Robinia pseudacacia, white locust; yellow locust, N. Y.
Robinia hispida, honey locust. N. Y.
Desmodium rotundifolium, hive vine. West Va.
Desmodium Canadense, beggar's lice. Concord, Mass.
Lathyrus odoratus, posy peas. Franconia, N. H.
Apios tuberosa, ground-pea. N. E.
Cassia Chamæcrista, magotty boy bean. N. Y.
Gleditschia triacanthus, thorn locust. N. Y.
Richardsonia scabra, Mexican clover. Ala.

ROSACEÆ.

Prunus Americana, hog plum. Tex.
Prunus Chicasa, mountain cherry. Md.
Prunus pumila, sand cherry. Common among nurserymen.
Prunus Pennsylvanicus, bird cherry. Penobscot Co., Me.
Prunus demissa, choke-cherry. Neb.
Prunus Caroliniana, cherry laurel; wild orange; mock-orange; wild peach. Southern States.
evergreen. Ga.
Prunus ilicifolia, Spanish wild cherry; mountain evergreen cherry. Cal.
islay. S. Cal. and W. Arizona.
Prunus fasciculata, wild almond. So. Utah.
Spiræa salicifolia, queen of the meadows. N. Y.

[1] Name of the Saranac River comes from this.

[2] A "loco-plant," producing in horses coma, or a loss of consciousness with power of locomotion still retained. Finally emaciation and death. Dr. M. Stalker, Ames, Ia.

Spiræa lobata, sweet William. Brunswick, N. Y.
Gillenia stipulacea, Injin physic. Banner Elk, N. C.
Rubus odoratus, thimble-berry. West Va.; N. Y.; Ferrisburgh, Vt.
Rubus occidentalis, blackberry. Ann Arbor, Mich.
black cap. N. Y.
Rubus villosus, "sow-tit" (teat). N. H.; Farrington, Conn.; Goshen, Conn.
finger berry; thimble berry. N. Y.
thimble berry. Ann Arbor, Mich.
Dalibarda repens, dew drop. N. Y.
Geum rivale, chocolate.[1] Buckfield, Me.; Franconia, N. H.
maiden hair. Brodhead, Wis.
Geum triflorum, Johnny smokers.[2] Rockford, Ill.
Potentilla Canadensis, sinkfield. West Va.
Agrimonia Eupatoria, stick seed; beggar's ticks. West Va.
Pyrus Americana, Indian mozemize; moose misse. Ferrisburgh, Vt.
Cratægus coccinea, thorn-bush. Penobscot Co., Me.
Cratægus coccinea, var. *mollis*, red haw. Gen. in Central States.
Cratægus Crus-galli, Newcastle thorn. N. Y.
Cratægus æstivalis, apple haw. Ala.
Cratægus brachyacantha, pomette bleue. N. W. La.; E. Tex.
hog's haw. N. W. La.; E. Tex.
Amelanchier Canadensis, snowy medlar. N. Y.
sugar-plum. Vt.
sugar pear. Orono, Me.
sugar berry. N. Woodstock, N. H.
sand cherry. Mont.
Adenostoma fasciculatum, chamise; chamise brush. S. Barbara Co., Cal.
Lyonothamnus floribundus, iron wood. Ids. of Sta. Catalina and Sta. Cruz, Cal.
Heteromeles arbutifolia, tollon; toyon. Cal.
California holly. S. Barbara Co., Cal.

CALYCANTHACEÆ.

Calycanthus floridus, sweet-scented shrub. No. O.
strawberry-bush. E. Mass.
Calycanthus glaucus, bubby-bush. Banner Elk, N. C.

SAXIFRAGACEÆ.

Saxifraga (*Virginiensis?*), lungwort. Calais, Me.

[1] Decoction of root sometimes used as a beverage.
[2] Applied at time of fruiting, when conspicuous with plumose styles.

Saxifraga Mertensiana, cocoanuts.[1] So. Cal.
Tiarella cordifolia, Nancy-over-the-ground. Mass.
white cool-wort. N. Y.
Mitella diphylla, false sanicle; fringe cup; fairy cup. N. Y.

CRASSULACEÆ.

Sedum Telephium, life of man. Concord, Mass.
Diamorpha pusilla, red moss. Hancock Co., Cal.
Cotyledon laxa, rock moss. S. Barbara Co., Cal.

HAMAMELIDÆ.

Liquidambar styraciflua, alligator-wood. W. Va.

MELASTOMACEÆ.

Rhexia Virginica, handsome Harry. Hanover, Mass.

LYTHRACEÆ.

Cuphea petiolata, tar weed. West Va.

ONAGRACEÆ.

Ludwigia alternifolia, seed-box. West Va.
Epilobium angustifolium, fire-top; burnt weed. Penobscot River, Me. (lumbermen).
Œnothera biennis, scurvish. Franconia, N. H.
fever-plant;[2] coffee-plant.[3] Eastern States.
king's cure-all. Southern States.[4]
Œnothera fruticosa, wild beet.[5] West Va.

CUCURBITACEÆ.

Cucurbita perennis, Chili cojote; calabazilla. So. Cal.
Megarrhiza Californica, man-in-the-ground.[6] S. Barbara Co., Cal.

FICOIDEÆ.

Mesembryanthemum æquilaterale, beach apple. S. Barbara Co., Cal.

Cambridge, Mass.

[*Reprinted from plates kindly furnished by the Journal of American Folk-Lore.*—EDS.]

[1] On account of having bulbs commonly dug up and eaten by children.
[2] Used as a diaphoretic in fevers.
[3] Infusion used as a drink in the harvest field.
[4] Used in domestic medicine.
[5] Used as a pot herb.
[6] So named from the enormous roots.

BRIEFER ARTICLES.

Natural history specimens in mails for foreign countries.—The following notice has lately been distributed to postmasters: The United States Post Office Department having submitted a proposition to so amend the universal postal convention of Vienna as to admit packages containing natural history specimens to the mails exchanged between countries of the postal union at the same postage rate and under the same conditions as apply to packages containing "samples of merchandise" in said mails, and said proposition having upon its submission to a vote of the countries composing the Universal Postal Union been rejected; the notice is hereby given that packages containing natural history specimens are not transmissible by mail to any country of the postal union (except Canada) except as *letters* upon which postage at the rate of five cents per half-ounce has been prepaid in full. . . .

The foregoing provisions do not apply to packages of natural history specimens addressed for delivery in Canada, the transmission of which is governed by the United States postal laws and regulations; nor to similar packages sent by "parcels post" to the countries named on page 930 of the United States *Official Postal Guide* for January, 1893. [These are: Bahamas, Barbadoes, Colombia, Costa Rice, Danish West Indies, Hawaiian Kingdom, Honduras, Jamaica, Leeward Is., Mexico, Salvador, British Guiana, and Windward Is.]

Postmasters will cause due notice of the foregoing to be taken at their offices.

By direction of the Postmaster-General, N. M. BROOKS, *Superintendent of Foreign Mails.*

EDITORIAL.

THE INCREASINGLY close organization of American botanists is a significant fact. In the beginning of their association the purpose was chiefly to cultivate personal acquaintance and to catch the inspiration that comes from an interchange of views. This has gone on until the great body of the working botanists of this country are thoroughly bound together by personal acquaintance and mutual esteem. A step further was taken when those interested in taxonomic nomenclature took advantage of their association to formulate a code of working rules, and thus turn into useful directions the energy that was being dissipated in the maintenance of differences. The next step was to adopt the co-operative plan of work, and with this idea the check-list

of the higher plants of the "manual range" has been prepared by a committee and referred to the Botanical Club for approval. In committee discussions and in those of the Club botanists have learned the value of a consensus of opinion, and have recognized that it is easier and far more effective to settle differences by arbitration than by war.

THIS LEADS us to speak of the relation of the principle of co-operation to the future of botanical work. The time has passed when any general botanical work should be prepared by a single individual, however capable that individual may be. Every work should appear with sufficient rapidity to insure completeness and uniform treatment. This is notably true in our most important systematic works, which have often been of such slow preparation that a whole generation has left them incomplete. Every botanist recalls the case of Dr. Gray's most elaborate works. Had the *Flora of North America* been pushed to completion by a group of botanists, it might not have been of equal excellence throughout, but it would have brought together all the information of the time, and established a definite point of departure for the subsequent study of all of our vascular groups. Had the *Synoptical Flora*, so fit a monument to our most distinguished systematist, called to its aid the rapidly increasing force of workers, it would now mark the second epoch of our knowledge of the North American flora, and would have had the masterly guidance of its projector, instead of being left, as it is, to an indefinite future. There is a time when details become so numerous that only organization can use them effectively. A general may be able to command a company better than any captain, but still he must be content to leave many details to others.

TO MARSHALL into orderly array all the known facts with reference to our North American flora is more than any one can do in a lifetime, and still all these facts must be brought together in the interest of progress. It is theoretically beautiful for one unusually capable systematist to traverse the whole field and monograph every group, but practically it is impossible. It is absolutely necessary to call in ordinarily capable workers and let them do the best they can. They may blunder, but they will surely get the facts into usable shape. No work pretends to be the last utterance upon any subject, but simply the foundation for future utterances, and it is always important that our information be kept current and within easy reach.

THE CO-OPERATION referred to involves not merely the allotment of work, but also the exchange of specimens and publications. It is impossible for all capable workers to reside at the greatest center of

material, but it is perfectly possible for those centers to equip them temporarily for work. That selfish hoarding of material which fears that some one else will get the benefit of it is not only contrary to the real scientific spirit but shows an entire lack of appreciation of the greatness of the field. It must be said that in this country, at least, almost every botanist is ready to open his collections and his library to all who know how to use them, and in so doing feels that he is advancing the interests of botanical science.

WHAT HAS BEEN SAID of co-operation in systematic botany obtains in almost every field of botanical work. It is a question whether any one man should prepare a complete work upon so young a subject as Physiological Botany, for it is impossible for him to examine the whole field, and certainly not in Morphology. Of course reference is not made to brief, compiled texts, but to monographic work. In this connection it may be said that a suggestion was made at the Madison meeting which would be immensely useful if carried out, namely, that botanists arrange for an exchange of index cards, each contributor being assigned certain publications for indexing, the cards being printed in uniform style and sent to all the others. This sort of co-operation would speedily lead to even more complete and effective organization of work.

IT IS CERTAINLY true that the progress of botanical science in this country, and in all countries, will be very much hastened by the completest possible organization of co-operative work.

CURRENT LITERATURE.

A new high school botany.[1]

A suitable botanical text-book for high schools seems to be the unsolved problem of publishers and teachers. The attitude of publishers is easy to understand, but that of teachers is not so simple. The only botanists who feel that a suitable book for such a purpose has been written are those who have written them, and the books in their own hands and in those of their own disciples are eminently satisfactory. Every good teacher has his own method, and it is not at all surprising that no one else expresses it exactly. Professor Spalding is an exceptional teacher and has produced an excellent book. It is intended to apply to the present condition of high school equipment and teachers and is surely a vast improvement upon "analysis." The

[1] SPALDING, VOLNEY M.—Guide to the study of common plants, an introduction to botany. 12 mo. pp. XXIII+246: Boston, D. C. Heath & Co., 1893.

book is a laboratory guide rather than a text-book, although it constantly associates form with function and gives frequent excellent summaries. It undoubtedly directs to proper methods of observation and seeks to cultivate the true scientific spirit. The serious question will be raised whether such a book should encourage the "actual state of things in most of our preparatory schools" or should show the same schools what the state of things ought to be in order to properly teach botany. The present book begins with an excellent series of studies of the organs of flowering plants; then considers the natural groups, beginning with algæ (Spirogyra and Vaucheria being used as types), and passes at once to the bryophytes, pteridophytes, and spermaphytes, paying increasing attention to groups as the advance is made. The theory of presentation is of course to cultivate the habit of proper observation with those large plant organs that are commonly known; in other words, to proceed from the complex to the simple. To many botanists this position will seem untenable. In the writer's experience the best results have been obtained by presenting the plant kingdom from the standpoint of its evolution, beginning with units of structure and function. Besides this, the morphology of the flower is impossible of conception except by approaching it by way of the lower groups.

Another question that can be raised concerning the book is the very scant attention it pays to thallophytes. Few types, well selected, are always to be preferred in elementary work to that large array of forms which is so common, forms which stand as so many isolated facts, and when observed, and sketched, and lectured upon are as barren as a sandbank. Too many types are confusing, but surely it would have been well to have introduced some of the great groups of fungi. Not a single reference even to the existence of such plants occurs, so far as we have observed!

All these, however, are questions which concern the theory and practice of the individual teacher. The teachers who use it, and we trust they will be many, will need to make a judicious selection of work from the pages. Blessed is he who knows what to leave out!

But the book is certain to be a very useful one. It is a long step in advance of anything we have for high schools. Professor Spalding is to be congratulated upon his book and the scientific spirit which pervades it.

We note some antiquated references which ought to be corrected in a future edition. Bower's Practical Botany is referred to as "Bower and Vines . . . Parts I and II," when they have long been combined in one volume and Dr. Vines' name has been withdrawn. Un-

derwood's "Our Native Ferns" is referred to as published at Bloomington, Ill., in 1882. This was the second edition, published by the author. But the author has not resided at Bloomington for ten years and the *fourth* edition of the book has lately been issued by Henry Holt & Co.

A course of practical elementary biology.[1]

Regarding this book we speak only of the botanical portion. It would have stated better the facts in the case if the author had called this a course of *impracticable* biology. We doubt whether any class of students ever pretended to work through the book. If they have, it surely must have taken some years, with daily work, to accomplish the feat. It strikes us rather as a thorough account of the morphology and physiology of the organisms chosen, interspersed with directions to study certain things or perform some experiments. For example, students are directed (p. 107) to "examine the nuclei of various cells, from the apical cell downward" in picric-acid-hematoxylin specimens of Chara in order to study the division of the nucleus! They are also directed (p. 136) to grow fern prothallia and study the history of their development, and likewise the development of the sexual organs. They are also asked to investigate the development of the pollen in Lamium album, the origin of the ovule and the structure of the egg apparatus.

The foregoing are only selected as examples of the impossible in an *elementary* course. We have little fault to find with the accuracy or mode of presentation of the matter of the book. It contains many useful hints for advanced students regarding the plants treated, which are yeast, protococcus, bacteria, mucor, penicillium, chara, the male fern, and dead nettle. Teachers also may be able to make use of it in suggesting work for classes. But it is in no sense suitable for beginners, at least in this country. If English students can as babes assimilate such strong meat they must be sons of Anak indeed!

Chapters in modern botany.[2]

This is one of the most charming and instructive books we have seen. If University Extension had done nothing for the people it could be credited with much good to botanists in bringing about the production of this book, which is one of a series of manuals issued by the Scribners. Its title tells just what it is; not a text book nor a

[1] Bidgood, John.—A course of practical elementary biology. Crown 8vo., pp. viii + 353. figs. 226. New York, Longmans, Green & Co. 1883. $1.50.

[2] Geddes, Patrick: Chapters in modern botany. 12mo. pp. xii + 201. figs. 8. New York, Charles Scribner's Sons. 1893.

"botany" but a series of sketches "beginning indeed with some of the strangest forms and processes of the vegetable world [which] it is not proposed to exhibit merely as a vegetable menagerie of rarities and wonders, but for use as a convenient means of reaching . . . some general comprehension of the processes and knowledge of the forms of vegetable life . . . [and] some intelligent grasp of the experimental methods and reasoning employed in their investigation."

These "chapters" treat therefore of pitcher plants and other insectivorous plants, movement and nervous action in plants, the web of life (the relation between plants of different groups), the relations between plants and animals, spring and its studies, leaves, and finally suggestions for further studies.

Those who have read from Professor Geddes before need not be told that the style is charming and his expressions apt and striking. We can not begin to quote these; there is no end. We can only say that no teacher or lover of botany can in justice to himself fail to read these pages. We would also that this book might come into the hands of all the multitude to whom botany is yet mere herborization and the botanist a harmless gatherer of simples. To all it is most cordially commended as fully reaching its declared purpose.

Minor Notices.

In connection with the botanical exploration of Costa Rica (*Primitiæ Floræ Costaricensis*, Durand and Pittier), Dr. F. W. Klatt has just published the Compositæ. Like other Central American states, the Eupatoriaceæ afford the most abundant display, the genus Eupatorium being represented by thirty species, ten of which are described as new. Fourteen other species are described as new, distributed among Senecio, Mikania, Viguiera, and several other genera. The total number of the list is 165.

To those interested in Diatoms, the volume[1] by Mills and Deby will be welcome. Some seventy-five pages are given to general information about diatoms, which might be much better without being first class, followed by analytical keys of families and genera (species not being considered), and rather incomplete directions as to collecting mounting, and photographing. The rest of the book (about 165 pp.) which is far the most important, indeed the indispensable, part of it, consists of the bibliography of the group, by Julien Deby.

Part III of John Donnell Smith's "Enumeratio Plantarum Guat-

[1] Mills, F. W. and Deby, Julien.—An introduction to the study of the Diatomaceæ, with a Bibliography. 8vo. pp xi. + 243: London, Iliffe & Son; Washington, The Microscopical Publishing Co., 1893.

emalensium" has just appeared. The very complete way in which Captain Smith is bringing to light this interesting flora leaves little to be desired. The explorations are thorough, the notes full, the specimens abundant. The material is a pleasure to study and to receive into the herbarium. It is fortunate that such collectors as the missionary, Theophilus Heyde, and his grandson, Ernest Lux, can be called upon. In the present distribution specimens also from W. C. Shannon and M. M. Macomb appear.

A STUDY of the venation of Salix has been published by Dr. N. M. Glatfelter and distributed in advance of the fifth annual report of the Mo. Bot. Garden. The species considered are those of Gray's Manual, and the author has provided valuable supplemental aid in their determination. Remembering how frequently leaf characters are the only ones obtainable in this genus, and also how important a group it is to the paleobotanist, venation characters should be made to reveal all they can. The species are separated into three groups, (1) those with secondary veins regular, (2) those with secondaries partly irregular, and (3) those with secondaries irregular. The secondaries have to be used, as the primaries are regular almost without exception. Three artotype plates illustrate the paper, having been photographed from the leaves by tramsmitted light.

"FOREST INFLUENCES" is the subject of Bulletin no. 7, from the Forestry Division of the U. S. Department of Agriculture. Mr. Fernow very conveniently gives a summary of conclusions in the introductory pages,some of which are as follows: *Influence on meteorological conditions*, (1) the general influence of the forest on soil temperatures is a cooling one; (2) the annual range of air temperature is smaller in the forest than in the open; (3) the mean temperature of the air in the tree-tops is rather higher than over open fields; (4) the forest affects the temperature just as any collection of inorganic obstacles to sunshine and wind, but as an organic being the forest may be also an independent source of heat; (5) the annual evaporation within the forests is about one-half of that in the open field. *Influence on climate of surrounding country*, (1) can only take place by diffusion of vapor of transpiration, (2) local air currents are induced by difference of temperatures of air within and without the forest, (3) the general air currents are cut off entirely in their lower portions by the forest. *Influence on water and soil conditions*, (1) deforestation augments and accelerates soil evaporation, and thus affects unfavorably the size and continuity of springs, (2) snow is held longer in the forest and its melting retarded, (3) surface drainage is retarded by the uneven forest floor, (4) the well-kept forest floor prevents erosion of soil better than even the close sod of a

meadow. *Sanitary influence*, (1) the claimed influence of greater purity of air does not seem to be significant, (2) protection against sun and wind and consequent absence of extreme conditions seem favorable, (3) the soil conditions of the forest are unfavorable to the production and existence of pathogenic microbes.

THE REPORT of the U. S. Microscopist for 1892 is devoted principally to edible and poisonous mushrooms. There are two other pamphlets sent out with it, being reprints of such parts of the reports for 1885 and 1890 as relate to edible fungi. They contain some very good colored plates and some serviceable information, although as contributions to science they do not rank high, and the accuracy of the statements is not always above criticism.

OPEN LETTERS.

A suggestion in terminology.

The members of the Madison Botanical Congress through their committees on the terminology of morphology and of physiology expressed a desire for some general term that should be applied to the cell which arises from the fusion of two gametes. The word zygote has come to refer only to the product of fusing isogametes, just as oösperm (in the etymologically correct use) refers to the fusion product of heterogametes. For the general term, after much research and deliberation, the compound *syngamete* is offered. The derivation is apparent, and by preserving the word gamete as an integral part of the term, there is little difficulty in respect to comprehensibility. Some such word seems better than one in which the idea of fusion alone should be expressed, for such a word would find proper use in the morphology and physiology of Mycetozoa. But in these it is very doubtful indeed whether the fusing *plasmodiogens* are gametic in their nature. The term is herewith offered for criticism.—CONWAY MAC MILLAN, *University of Minnesota, Minneapolis.*

Introduced plants in the arid region.

I forward the inclosed list to show that though we dwell in the arid region we can show a very fair assortment of introduced plants and shrubs.

The list is made out from what grows on my two lots 100 by 300 feet in our village. The lots are bisected by a small river, the Vasquez Fork of the Platte, and is blessed with abundant moisture in part.

We are in latitude 39° 45′ 24″ north with an altitude of 5,660 feet above the sea. Our yearly rain-fall and melted snow varies from thirteen and one-half to eighteen inches.

Stachys and Deutzia are from Japan, and present no trouble in naturalization, if I permit them to extend.

Sonchus is a late visitor. This plant and Taraxacum threaten to ingulf all the rest, and to supersede Atriplex and Amarantus even in the richest soil. A portion of the two lots I never irrigate. Here the native plants resist all encroachment from introduced species.—E. L. BERTHOUD, *Golden, Colorado.*

[The accompanying list gives the names of sixty-five genera (species not named) of introduced plants. Of these six are indicated as having two species each introduced and one with three species. In addition there are seven of whose introduction there is some doubt.—EDS.]

NOTES AND NEWS.

DR. KARL VON DALLA TORRE has been called to the professorship of botany in the University of Innsbruck.

DR. H. MŒLLER, heretofore *privat-docent* in botany in the philosophical faculty of the University of Greifswald, has been called to a professorship.

THE FLORA of St. Vincent (W. Indies) is catalogued in a recent *Kew Bulletin* (Sept.). In this flora the Leguminosæ largely predominate, with the Gramineæ, Rubiaceæ, Compositæ, and Orchidaceæ following at a wide interval.

THE KEW *Bulletin of Miscellaneous Information* is being made more and more valuable to systematists. The July number contains the fifth decade of new plants cultivated at Kew, and the sixth decade of new orchids. The department of Miscellaneous Notes is also to be commended for the current information it contains.

THE SEVENTH annual report of the Botanist of the Nebraska State Board of Agriculture is chiefly made up of a preliminary description of the native and introduced grasses of the state, aided by numerous cuts in the text. The species number 154, and a call for the aid of observers throughout the state is made by Dr. Bessey.

THE ARNOLD ARBORETUM is the subject of very high praise from George Nicholson, Curator of the Kew Gardens, who recently visited it. His impressions concerning it appear in the *N. Y. Tribune* (Sept. 10th) and are copied in *Gardener's Chronicle* (Oct 7th). It is certainly true that this splended institution is too little known and appreciated in its own country.

DR. FRIEDRICH TRANGATT KUETZING, the distinguished algologist, died at his home in Nordhausen, Saxony, on the ninth of September in the eighty-seventh year of his age. He was born at Ritteburg in Thuringia, December 8, 1807, studied at Halle, was made professor of natural science in the Realschule at Nordhausen in 1835, and still retained the position at the time of his death.

UNDER THE LAW of homonyms, Professor E. L. Greene, in *Erythea* (October), proposes the name *Forsellesia* for *Glossopetalon* Gray, (1853), not Schreber (1789), and *Bourdonia* for *Keerlia* Gray (1852), not DC.

(1836), both of *Plantæ Wrightianæ*. Forselles was a Swedish mining engineer and botanical writer of half a century ago, and Bourdon a Parisian botanist in the earlier part of this century.

LIGNIER STATES[1] that a very concentrated alcoholic solution of vesuvin can be used to show up to advantage the lignified parts of silicified (fossil) plants. Sections cleaned in chloroform are placed for twenty-four hours in the solution, washed in absolute alcohol and mounted in balsam.

JENSEN finds[2] that Euglena viridis and Chlamydomonas pulvisculus show distinct geotropism, though usually the geotactic movements are overpowered by the directive influence of light, heat and chemical agents. Upon his experiments he bases a theory of geotropism of which the keynote is the differences of hydrostatic pressure in different sections of the organism.

THE FIRST half of an extensive contribution to the literature on the pollination of flowers will be found in the Botanisch Jaarboek[1] V (1893). 156–452. The work is by Dr. J. MacLeod and is illustrated by many excellent figures in the text. After the admirable pattern of Müller he gives an account of the relations between insects and flowers in a part of Flanders. The second installment will follow in volume six of the Jaarboek.

MR. ARTHUR BENNETT, in his notes on Potamogeton in *Journal of Botany* (October), considers two American species, *P. Spirillus* Tuck. and *P. fluitans* Roth. The former he considers to be *P. dimorphum* Raf., and under the latter considers the vexed question of its relation to *P. lonchites* Tuck., finally proposing to consider them distinct, the *P. fluitans* Roth not occurring in North America, and *P. lonchites* being a synonym of *P. Americanus* Chamisso.

THE MORPHOLOGY of the root tubercles of Leguminosæ is discussed by Dr. Albert Schneider, in the *American Naturalist* for September. The work was done in the University of Minnesota, and the general conclusions reached are that the tubercles are developed exogenously from a meristem area surrounding the infected region, have a well developed vascular system differing from that of the root, and anatomically resemble a stem more closely than a root.

IN 1889 the genera of Musaceæ (Banana Family) were presented by Petersen in Engler and Prantl's "Die natürlichen Pflanzenfamilien", and now, in the *Annals of Botany* (VII. 189–222), Mr. J. G. Baker publishes a complete synopsis of the same family. The true bananas (Musa) are naturally the most perplexing, Petersen estimating that there are about 200 cultivation forms, reducible to about twenty species. Baker presents them in thirty-two species, four of which are new.

IN A MEMOIR on the anatomy of the cell in fungi and filamentous algæ, W. Wahrlich shows that protoplasmic continuity exists very

[1] Bull. Soc. Linn. Norm. IV. VI (1892). 9.—Bot. Cent. LVI (1893). 18.
[2] Pflüger's Archiv f. ges. Physiol. LIII (1893). 428.—Bot. Cent. LVI (1893). 20.
[1] Issued by Dodonæa; publisher: J. Vuylsteke, Koestraat 15, Ghent, Belgium.

generally in the fungi, a strand passing through a simple central pore. He contests emphatically the presence of plasmic threads in the algæ, in opposition to Kohl. As to the division of the cells of algæ he repudiates the common theory of the origin of the transverse wall as an annular thickening and revives the old "box" theory, holding it to be formed as a true annular fold, following the contour of the shrinking protoplasm.

STAHL'S well known researches on the protective function of oxalic acid have been confirmed by a study of the distribution of oxalic acid and acid oxalates by Rudolf Giessler.[3] He finds them chiefly in the epidermis and peripheral tissues; in much smaller quantities, if present at all, in deeper tissues; generally wanting in underground parts. Tannin seems to serve as a protection when oxalic acid is wanting. His anatomical studies are complemented by experiments with snails and plant lice.

THE *Bulletin of the Torrey Botanical Club* for September contains the following papers read before the botanical section at the Madison meeting: *Williams* on Lichens of the Black Hills and their distribution; *Atkinson* on Symbiosis in the roots of the Ophioglossaceæ, and Photography as an instrument for recording the microscopic characters of micro-organisms in artificial cultures; and *Pammel* on Crossing of Cucurbits, a paper read by title, still further testifying by experiments to the fallacy of the popular belief that cucurbits hybridize.

IT SEEMS that the name *Halesia*, as applied to the "silver-bell trees" of the south and dedicated to the distinguished Stephen Hales, must disappear. In *Garden and Forest* (Oct. 18th) Dr. N. L. Britton points out that it is a homonym, the earlier *Halesia* of P. Browne being a West Indian tree, now *Guettarda* L. Under the circumstances the genus is very appropriately dedicated to Dr. Charles Mohr of Mobile, whose name should surely be connected with the southern forest trees. The three species, therefore, stand as *Mohria Carolina* (Halesia tetraptera), *M. diptera* and *M. parviflora*.

THE REINHOLD-GILTAY microtome, a machine of rather complex construction, but adapted to the finest work, is described by Dr. J. W. Moll in the *Zeits. f. wiss. Mikros.* IX (1892). 445–465. In the same paper he describes investigations on the tearing and compression of sections in cutting and the preparation of the knife to avoid these difficulties. He also sought out three polishing powders which give a proper edge for the best results. The first is iron oxide prepared by precipitating iron oxalate from solutions of ammonium oxalate and iron sulphate, drying, glowing, and rubbing up to a fine red-brown powder, (which, however, loses its sharpening power when it becomes red). The second is prepared by heating Mohr's salt in a Hessian crucible in a furnace until no vapor is given off, rubbing up the mass in water, washing and drying. The third is a polishing powder of unknown composition obtained under the name of "Diamantine no. 1." All three are used after polishing the knife edge with Vienna chalk. A piece of plate glass gives the best surface on which to use all such powders.

[3] Jenaische Zeits. f. Naturwiss. XXVII (1893). 341.—Bot. Cent. LVI (1893). 35

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(3) The Preliminary Catalogue of the Anthophyta and Pteridophyta reported as growing within one hundred miles of New York. 1888. Price, $1.00.

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